Development of a Portable X-Ray Computed Tomographic Imaging System for Drill Site Investigation of Recovered Core

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A portable x-ray computed tomography (CT) system was constructed for imaging core at drill sites. Performing drill-site-based linear x-ray scanning and CT analysis permits rapid evaluation of core properties such as density, lithologic structure and macroporosity distribution, and allows for real-time decision making for additional core handling procedures. Because of the speed with which scanning is performed, systematic imaging of all retrieved core is feasible. Innovations such as a novel clamshell shielding arrangement integrated with system interlocks permit safe operation of the x-ray system in a busy core laboratory. The minimization of the volume encapsulated with shielding reduces the overall system weight and facilitates the instruments portability.

The x-ray CT system was initially deployed on the Ocean Drilling Program's (ODP) research vessel JOIDES/Resolution, during Leg 204, 7 July to 2 September, 2002, Drilling Gas Hydrates On Hydrate Ridge, Cascadia Continental Margin. The x-ray system as originally fabricated had a 110 kV x-ray source with a 300 micron focal spot size. A 15 cm image intensifier with a cesium iodide phosphor input screen was coupled to a CCD for image capture. The system was used for imaging several hundred cores, each 1.5 meters long and 6 centimeters in diameter. Acquired images reveal significant detail of the retrieved oceanic sediment's macroporous structure. Follow up dissociation studies were performed on core containing massive hydrate using the x-ray CT system at the ODP Gulf Coast Core Repository. Small changes, attributed to the decomposition of methane hydrate into methane gas and water, were clearly discernable using difference imaging.

The CT system has since been modified with a 130 kV micro-focal x-ray source. With the x-ray system's variable focal spot size, high-resolution studies (10 micron resolution) can be performed on core plugs and coarser (50 micron resolution) images can be acquired of whole drill cores. An x-ray filter control system has also been incorporated, permitting rapid acquisition of dual-energy scans for more quantitative analysis of sample mineralogy. The x-ray CT system has operated reliably under field conditions and is currently being prepared for a drilling project near Prudhoe Bay, Alaska.